

# **Bosque/Leon Rivers Perchlorate Study**



**United States Army Corps of Engineers**



**Texas Commission on Environmental Quality**



**Brazos River Authority**



**The Institute of Environmental and Human  
Health at Texas Tech University**



**MWH**



**United States Environmental Protection Agency**



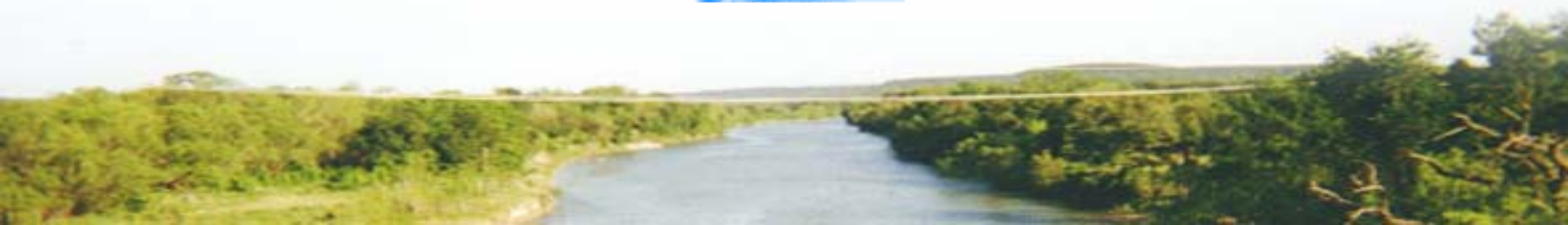
**City of Waco**

***Stakeholders Meetings***

***Temple , Tx- August 12, 2003***

# ***Introduction***

**Kyle Headley**  
**Regional Environmental Planner**  
**(Central Basin)**  
**Brazos River Authority**



# ***Agenda***

- **Introduction**
- **Ecological Evaluation**
- **Watershed Studies**
- **Conclusion**

*Kyle Headley (BRA)*

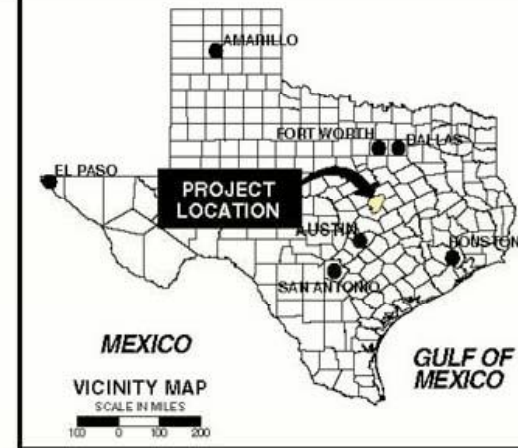
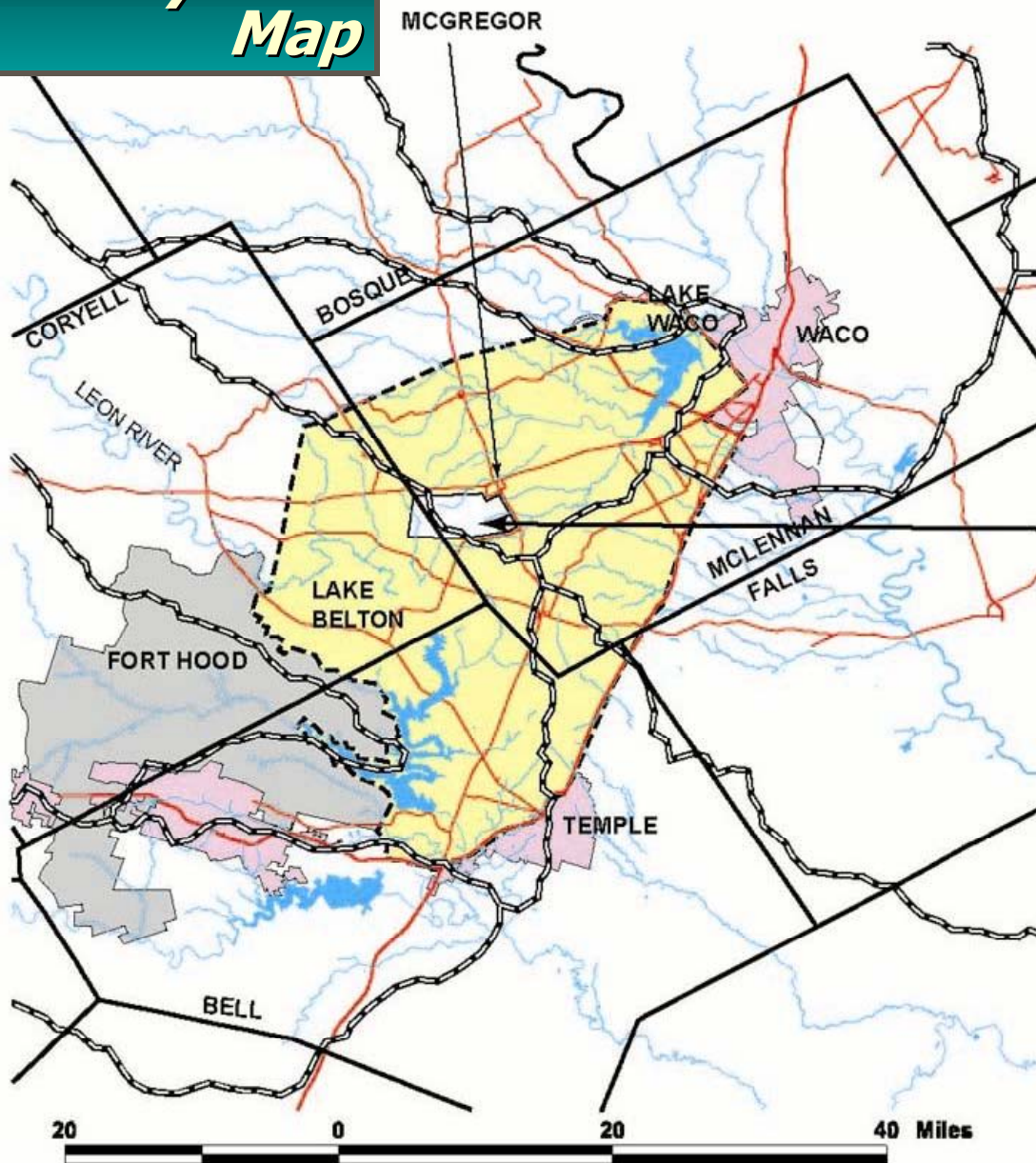
*Todd Anderson (TIEHH)*

*Ronald Hartline (MWH)*

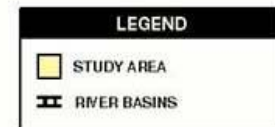
*Brian Condiike (USACE)*



# Study Area Map



NAVAL WEAPONS  
INDUSTRIAL RESERVE  
PLANT



BRAZOS RIVER BASIN, TEXAS  
BOSQUE & LEON RIVER BASINS

1 JANUARY 2001

U.S. ARMY ENGINEER DISTRICT, FORT WORTH, TEXAS  
SOUTHWESTERN DIVISION

# ***Project Goal***

**Evaluate potential human and environmental exposure to perchlorate in the lakes Waco and Belton study area.**

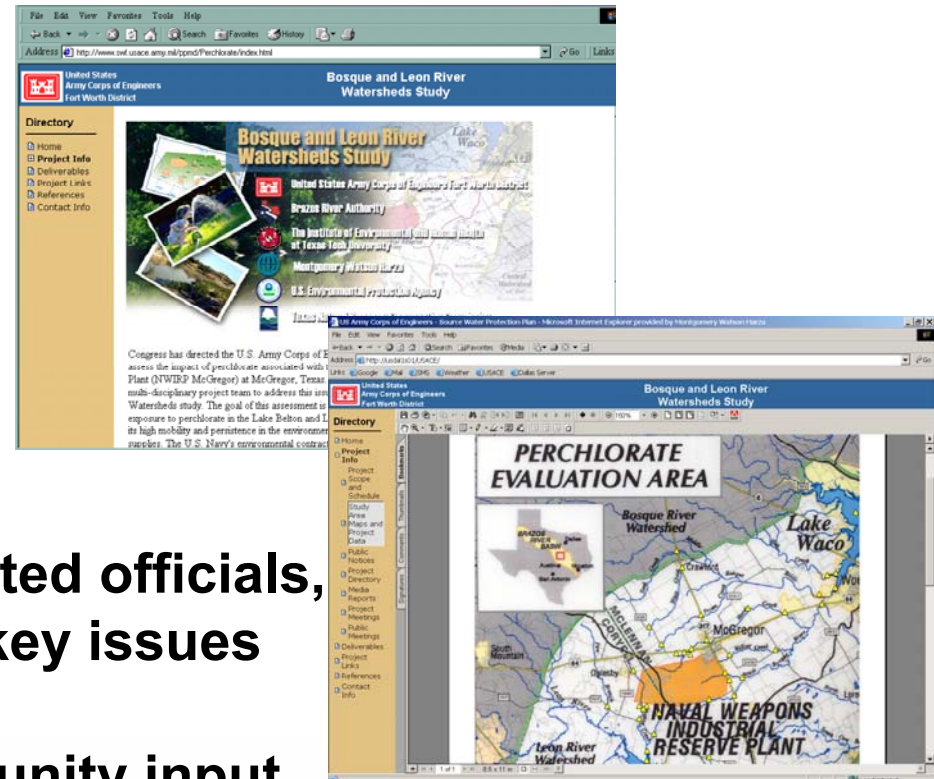
*--- Project Team (February 2000)*





# ***Community Outreach***

- Stakeholder interviews
- Community Relations Plan
- Stakeholder meetings
- Public meetings
- Briefings for elected official's
- Web site



## ***Benefits:***

- Ensures that stakeholders, elected officials, and the public are informed of key issues and project progress.
- Provides opportunity for community input

**[www.swf.usace.army.mil/ppmd/Perchlorate/index.html](http://www.swf.usace.army.mil/ppmd/Perchlorate/index.html)**

# *Objectives*

## Completed

- Develop effective community relations plan. ✓
- Compile existing study area information. ✓
- Identify data gaps in existing information. ✓
- Define and Develop the Conceptual Study Model (CSM). ✓
- Based on data gaps, develop Field Sampling Plans. ✓
- Field Investigation to fill the key data gaps. 90% Complete
- Evaluate fate and transport pathways. In Progress



# ***Objectives (Cont'd)***

## **Completed**

- Evaluate potential environmental exposure to perchlorate in the study area. **In Progress**
- Evaluate potential human exposure to perchlorate in the study area. **In Progress**
- Assess exposure pathways to vegetation, fish, birds, mammals. **In Progress**
- Assess impact on amphibians, fish, and large and small mammals. **In Progress**
- Integrate data and assess ecological risk **In Progress**





# ***Ecological Evaluation***

**Todd Anderson**

**The Institute of Environmental and  
Human Health**

**Texas Tech University**



# ***Ecological Objectives***

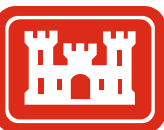
- **Identify Points and Pathways of Exposure**
- **Assess Impacts on Fish and Amphibians**
- **Assess Impacts on Mammals and Birds**
- **Model Long-Term Exposure and Effects**



# ***Points and Pathways of Exposure***

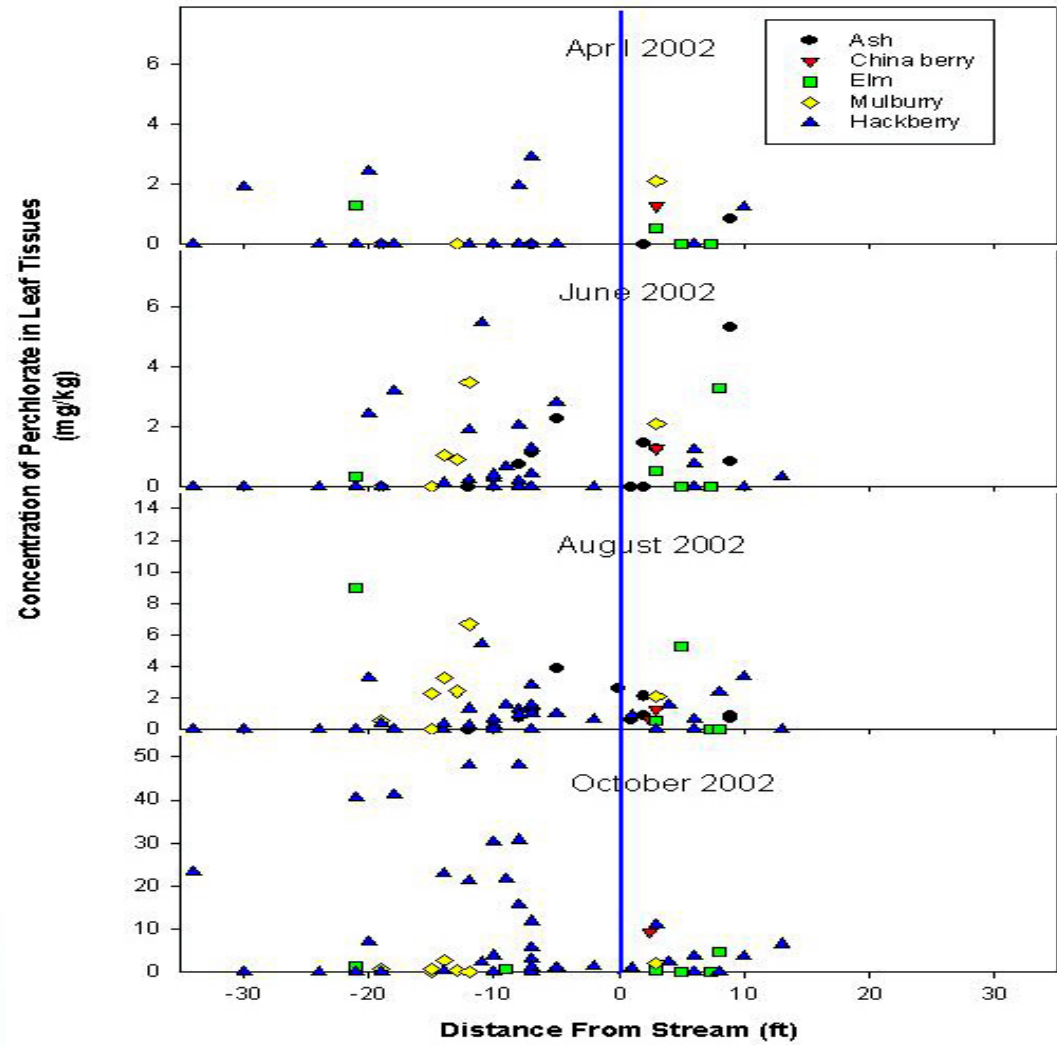
- **Water**
  - *varies with season*
- **Sediment**
  - *persistent*
- **Vegetation**
  - *perchlorate is present*
- **Fish**
  - *human exposure unlikely*





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# Perchlorate in Leaf Tissue



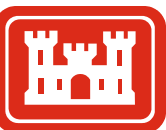
# ***Points and Pathways of Exposure***

## **Current Focus**

- Release of perchlorate from vegetation***
- Transformation of perchlorate in vegetation***
- Market basket-type survey***



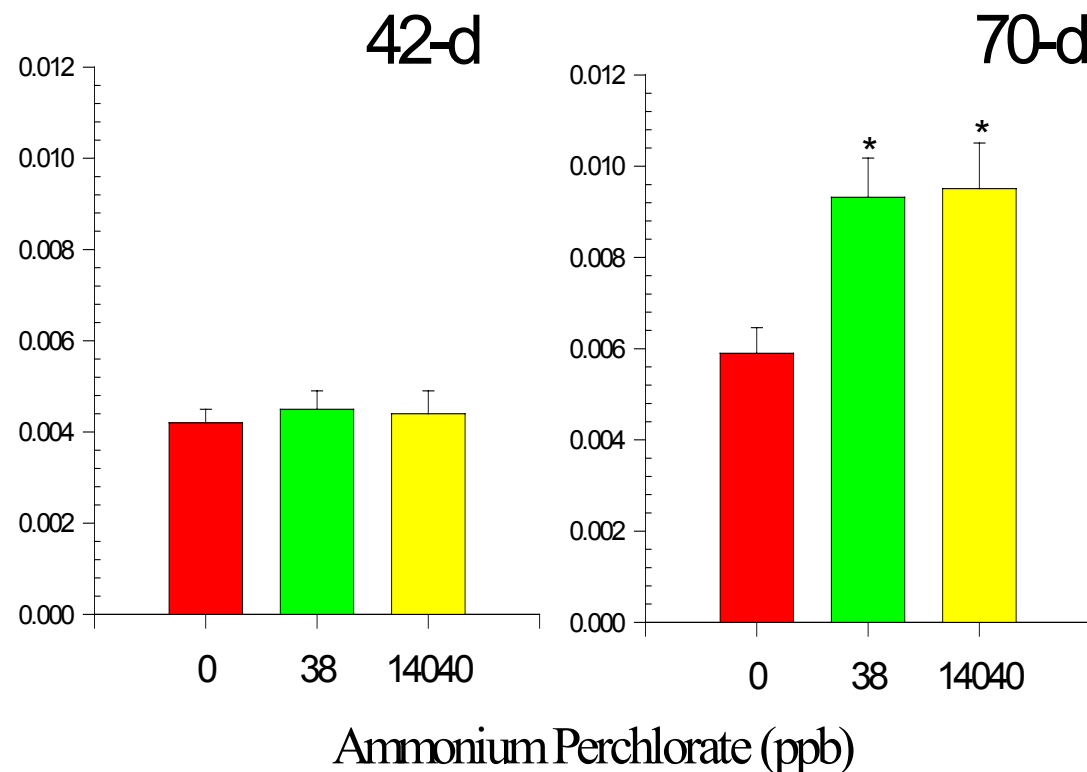


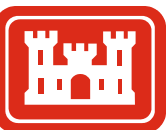


# ***Impacts on Fish and Amphibians***

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- **Frogs and Fish**
  - *thyroid histology*
- **Frogs**
  - *% male offspring*
- **Frogs**
  - *effects are reversible*

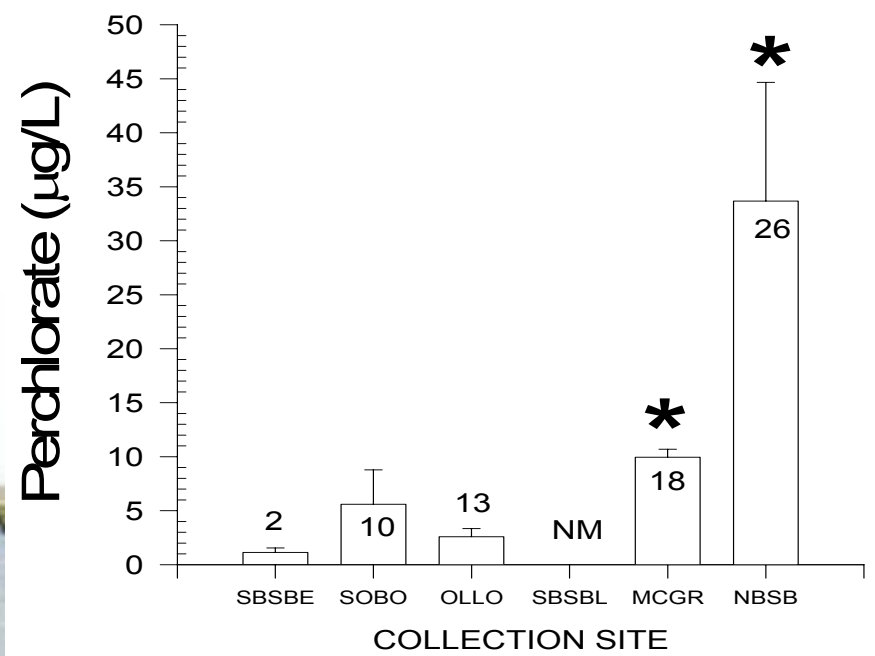
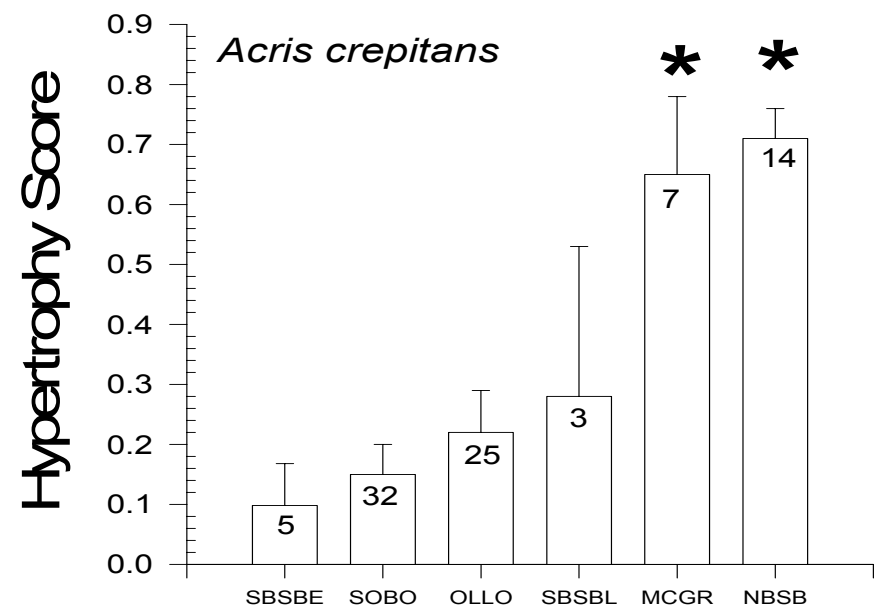




# Impacts on Fish and Amphibians

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- **Native Frogs and Fish**
  - *thyroid histology*



# ***Impacts on Fish and Amphibians***

## **Current Focus**

- Continue thyroid histopathological assessment***
- Frog development in water from study area***
- Perchlorate in edible fish tissues***



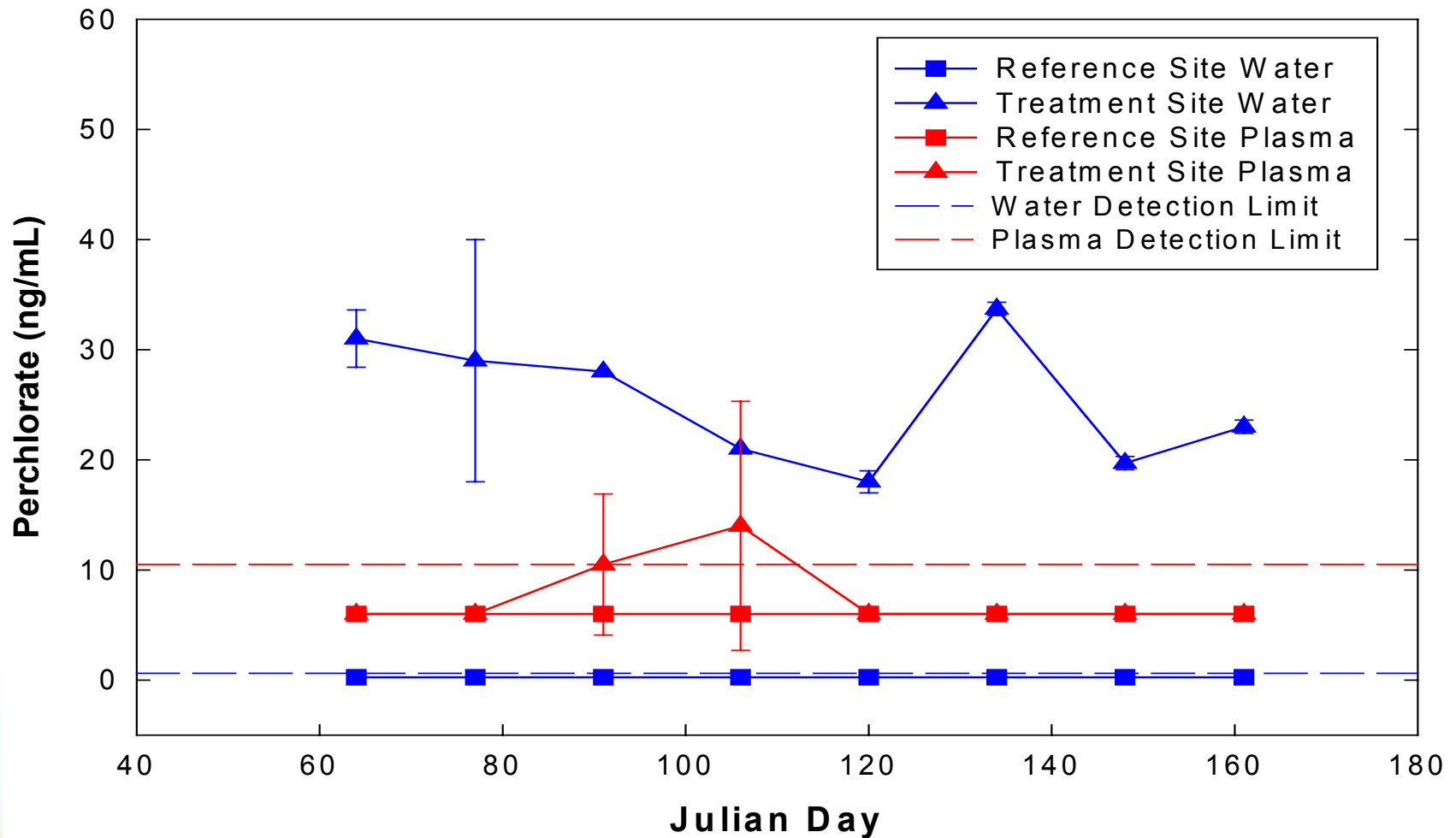
# ***Impacts on Mammals and Birds***

- **Small Mammals**
  - *significant exposure risk*
- **Medium Mammals**
  - *no exposure*
- **Small Birds**
  - *perchlorate is present*
- **Tissue Distribution**
  - *no definite pattern*





# *Impacts on Large Mammals*





# ***Impacts on Mammals and Birds***

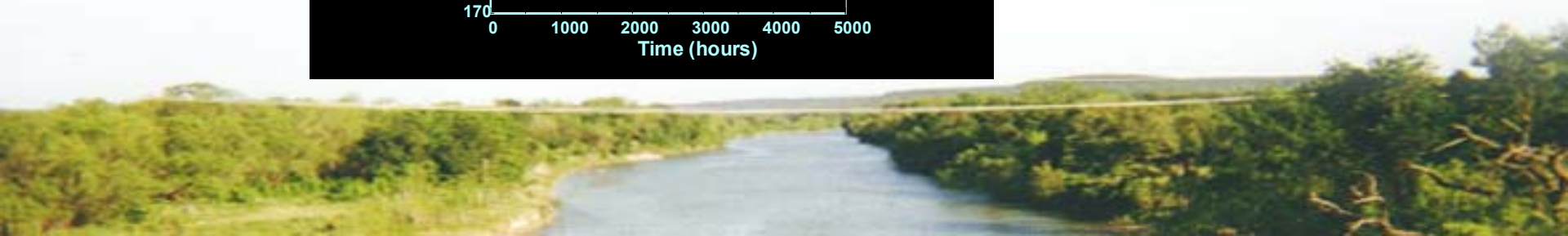
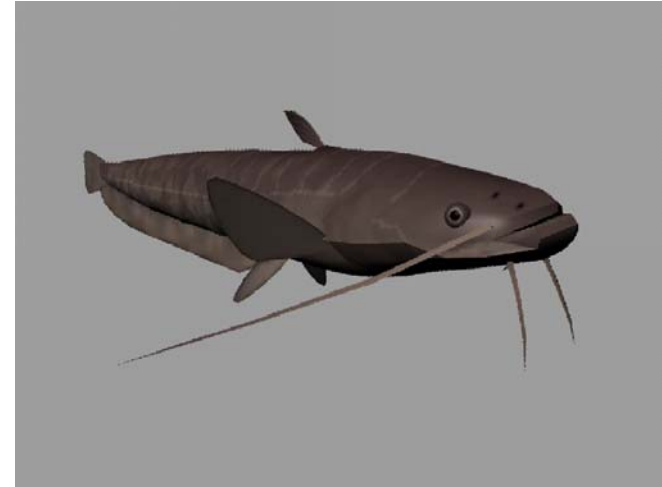
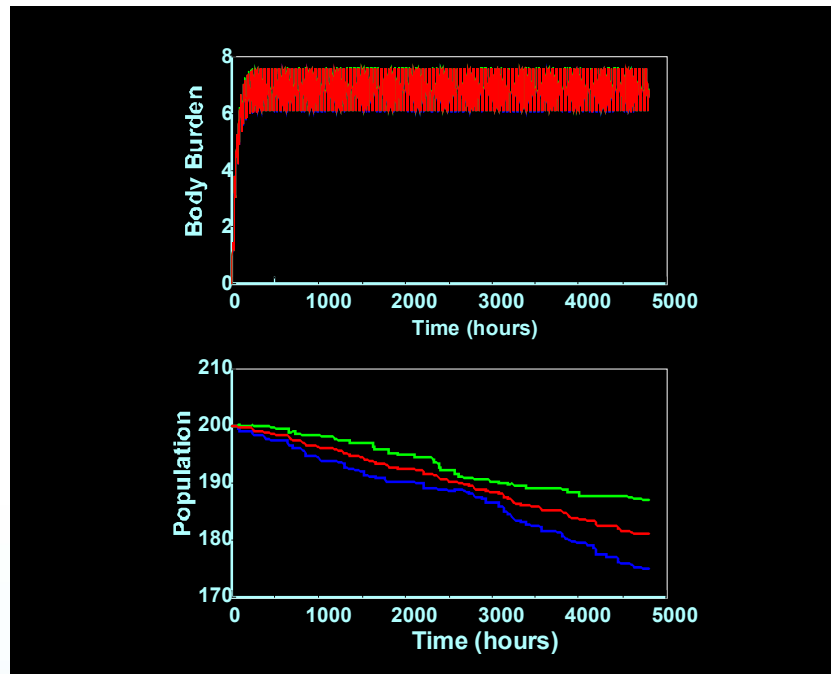
## **Current Focus**

- ***Laboratory tissue distribution studies***
- ***Potential impacts on thermal regulation***



# ***Model Long-Term Exposure and Effects***

- **Exposure and Effects Simulations**



# ***Model Long-Term Exposure and Effects***

## **Current Focus**

- Model refinement using collected data***

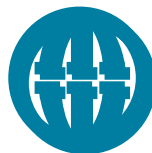




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# ***Watershed Studies***

**Ronald Hartline P.E.  
Principal Engineer  
MWH**





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# ***Watershed Study Components***

- Longitudinal stream sampling (bi-weekly and storm events)
- Belton & Waco delta area sampling (surface water, sediment pore water, algae, & golf course intake sampling from Lake Waco)
- Lake Belton Acoustic Doppler Current Profiler flow analysis
- Lake Belton Anoxic study
- Groundwater dye tracer study (Discontinued)





# *Automated Sampling Stations installed throughout watersheds*

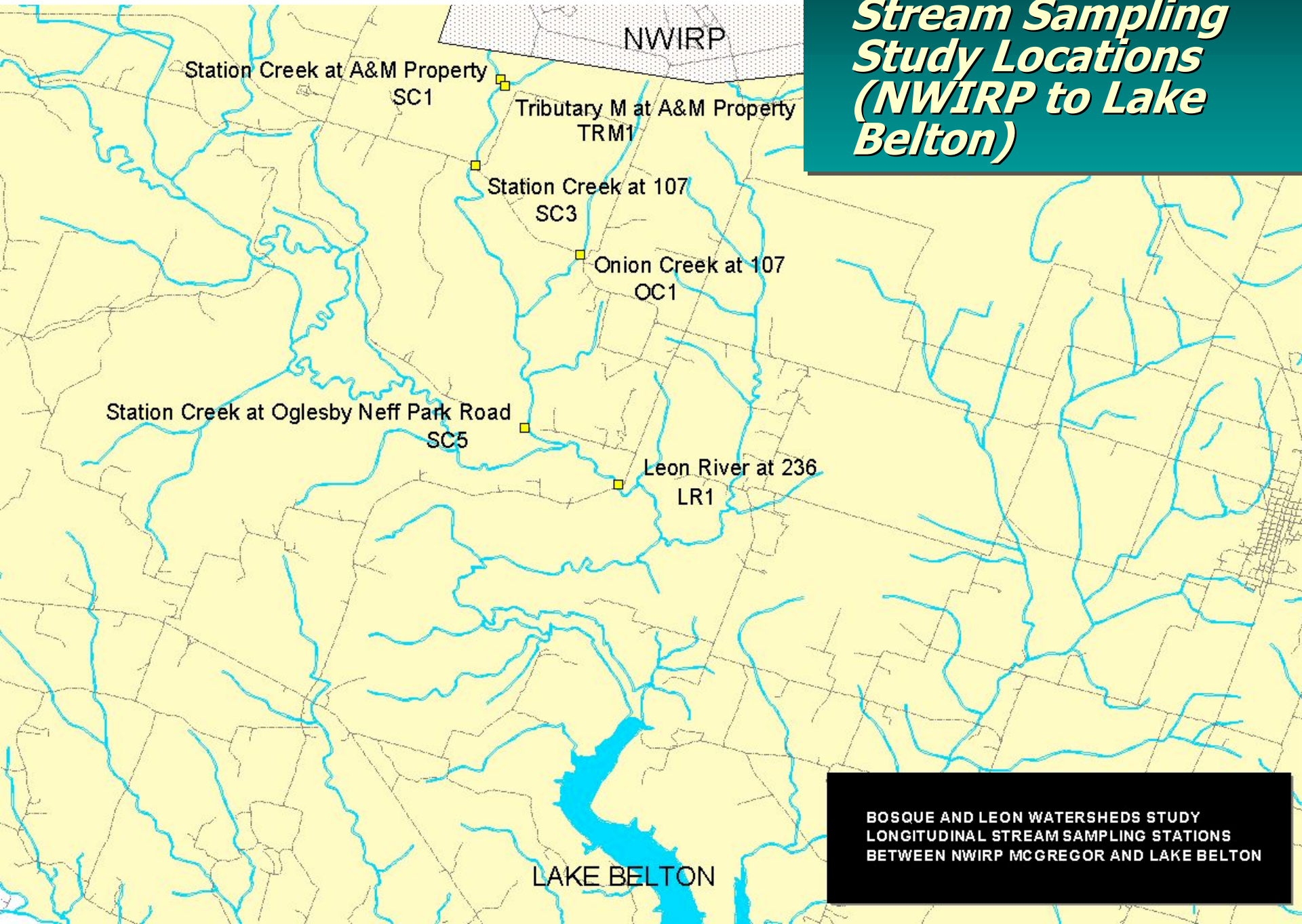


1196 samples  
analyzed to  
date





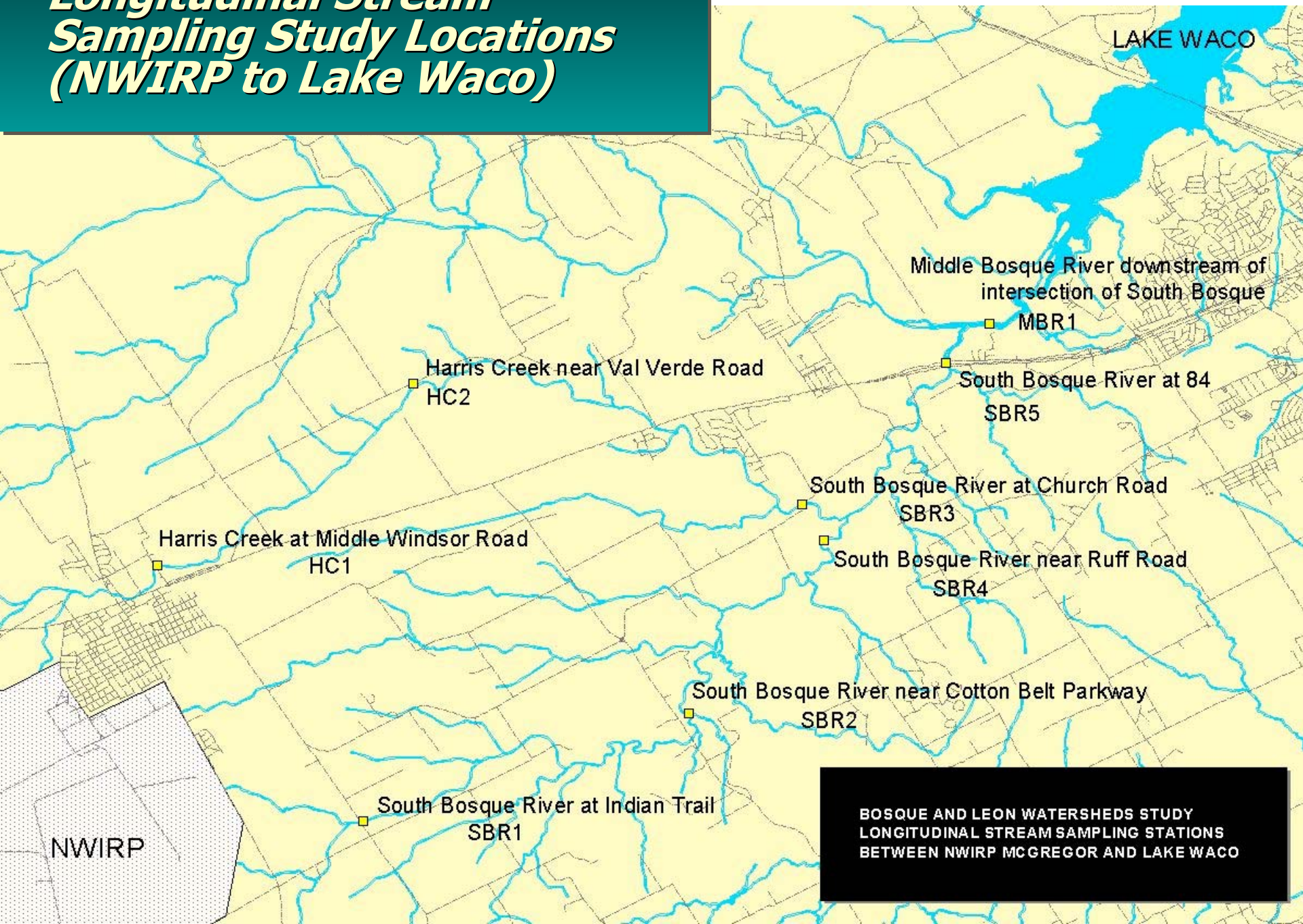
# ***Longitudinal Stream Sampling Study Locations (NWIRP to Lake Belton)***



BOSQUE AND LEON WATERSHEDS STUDY  
LONGITUDINAL STREAM SAMPLING STATIONS  
BETWEEN NWIRP MCGREGOR AND LAKE BELTON



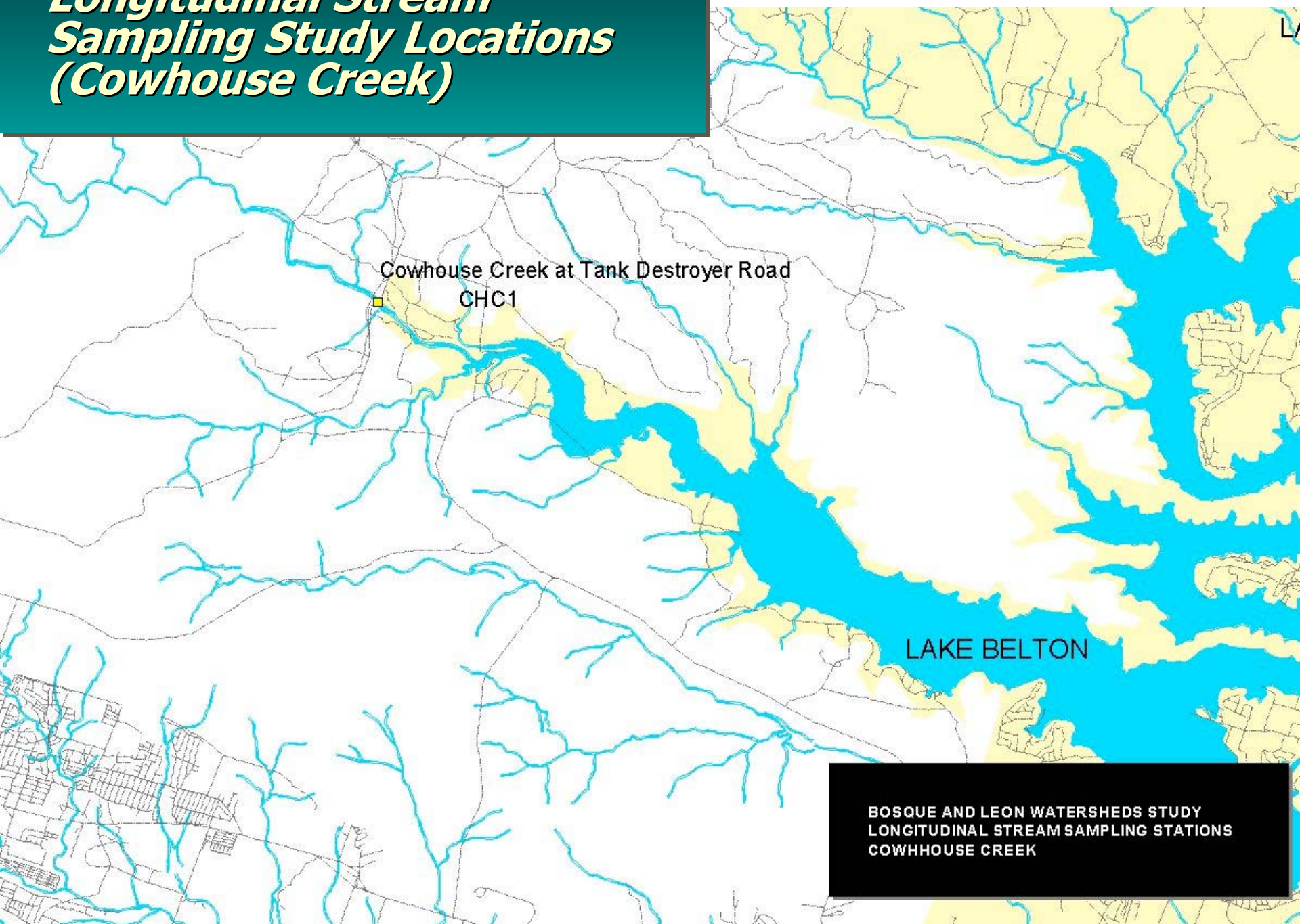
# ***Longitudinal Stream Sampling Study Locations (NWIRP to Lake Waco)***



**BOSQUE AND LEON WATERSHEDS STUDY  
LONGITUDINAL STREAM SAMPLING STATIONS  
BETWEEN NWIRP MCGREGOR AND LAKE WACO**



# ***Longitudinal Stream Sampling Study Locations (Cowhouse Creek)***



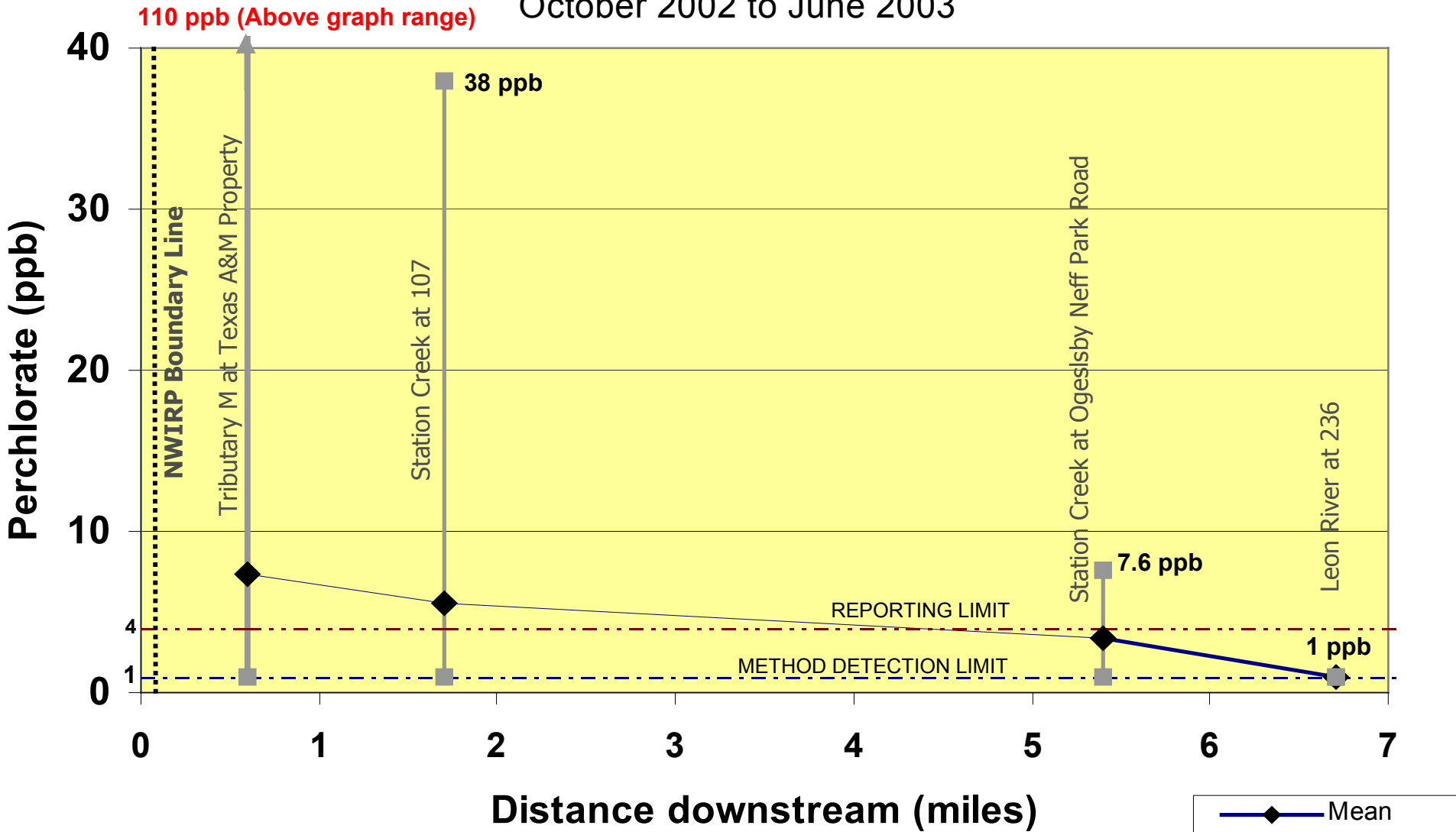
**BOSQUE AND LEON WATERSHEDS STUDY  
LONGITUDINAL STREAM SAMPLING STATIONS  
COWHOUSE CREEK**

# *Longitudinal Stream Sampling Study Perchlorate Concentrations*

## Surface Water Perchlorate Concentrations

(NWIRP to Lake Belton)

October 2002 to June 2003



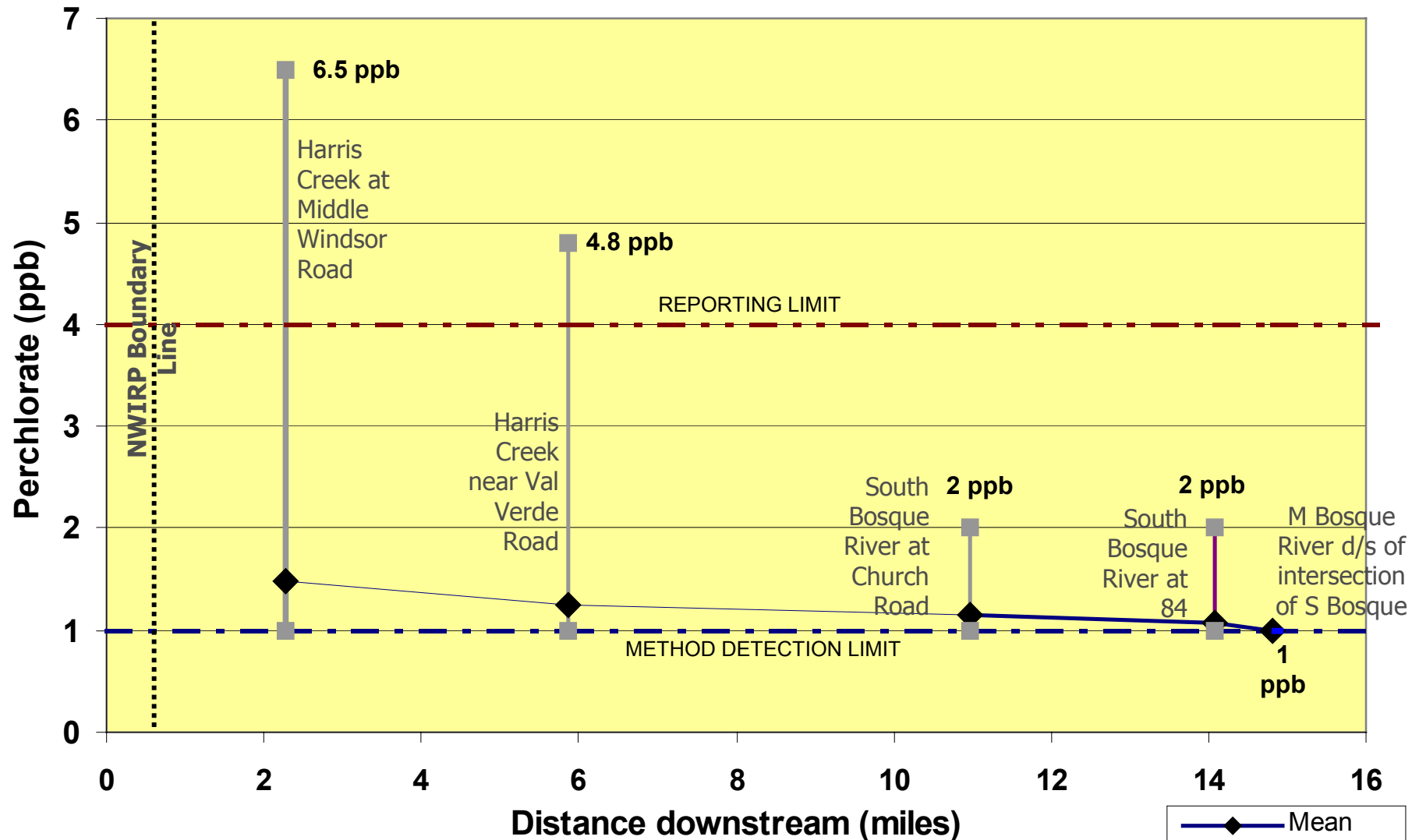


# *Longitudinal Stream Sampling Study Perchlorate Concentrations*

## Surface Water Perchlorate Concentrations

(NWIRP to Lake Waco)

October 2002 to June 2003

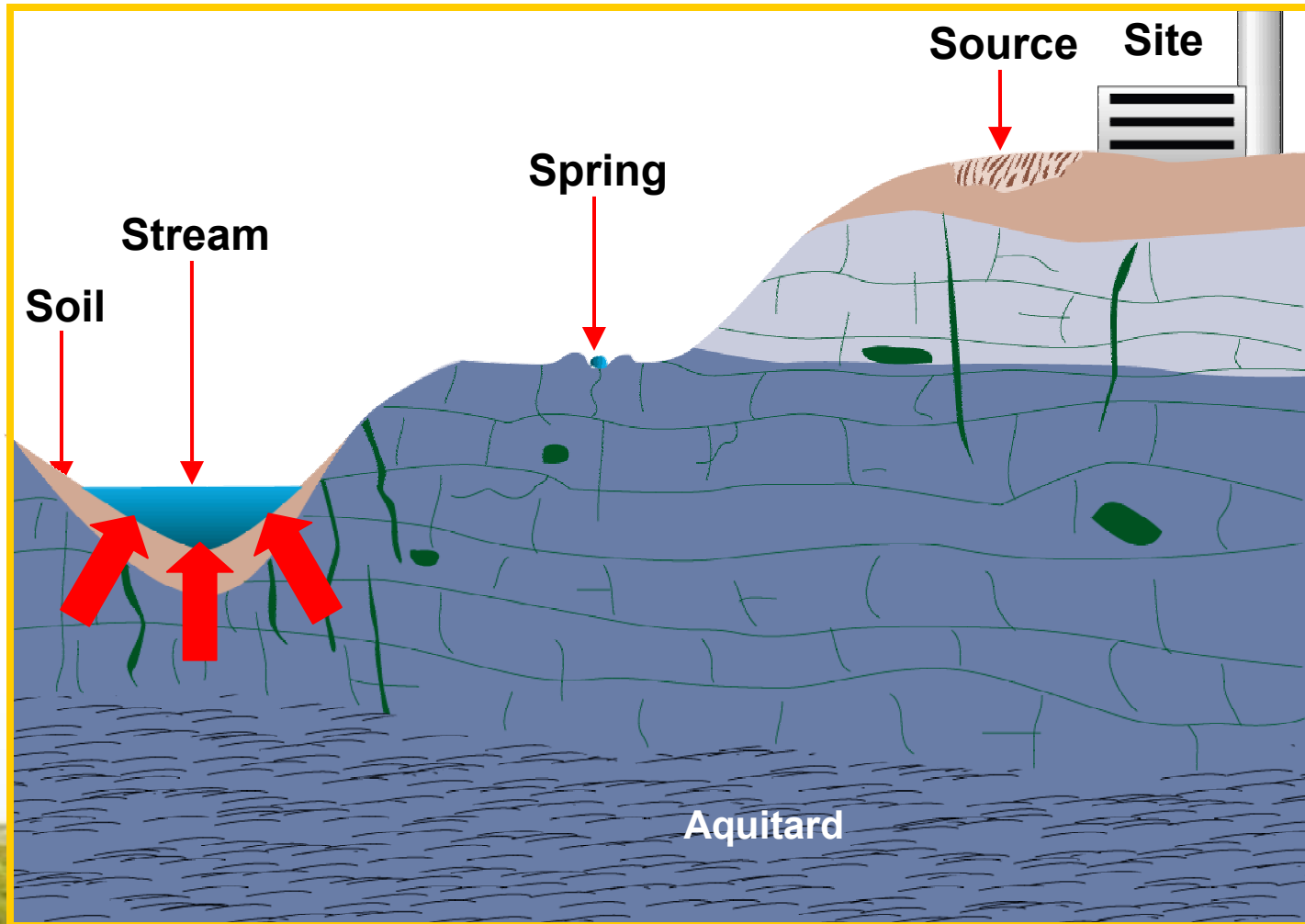




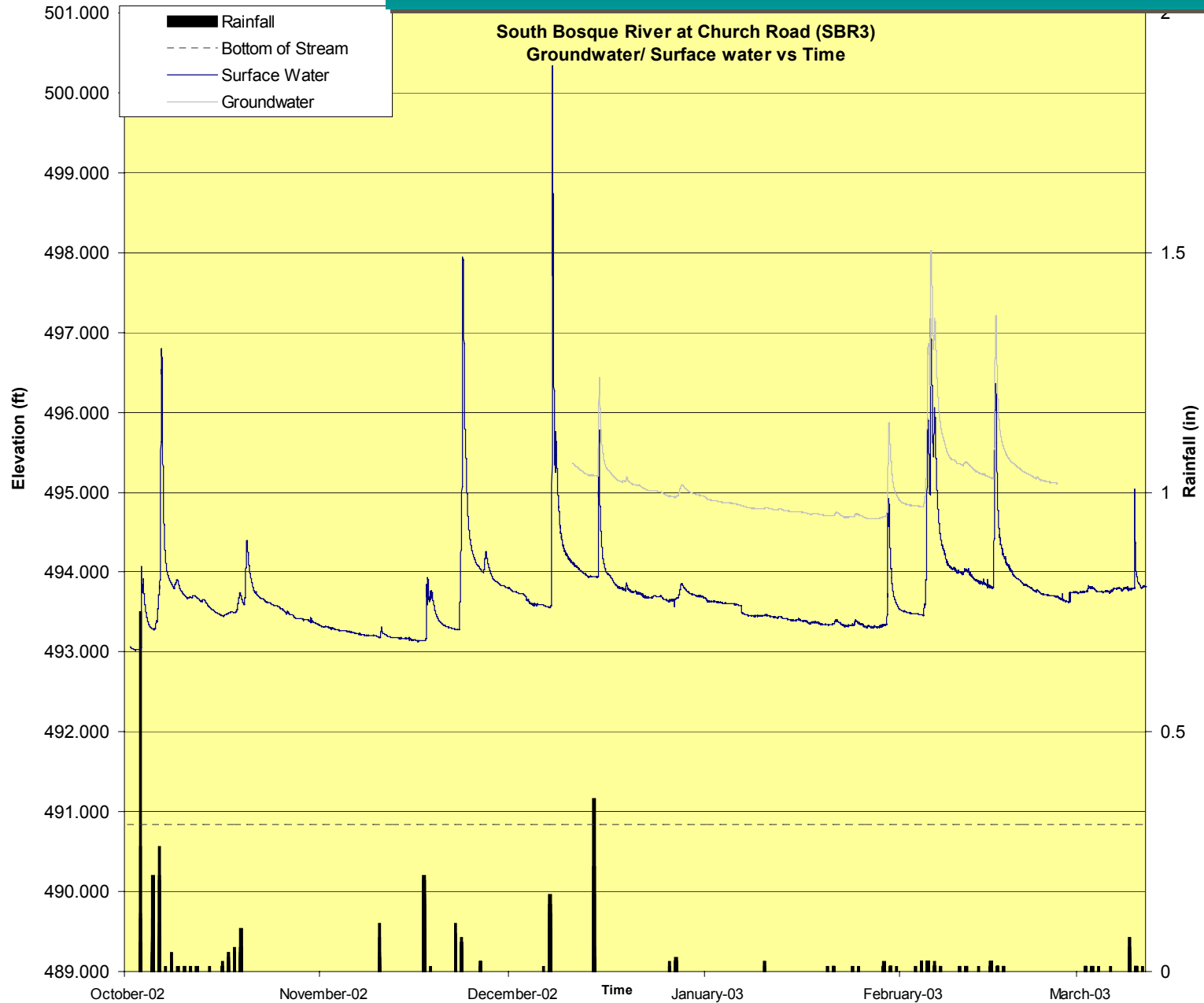
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# ***Conceptual Site Model***

## ***"Gaining" Stream***



# Surface Water levels, Groundwater levels and Rainfall Relationships

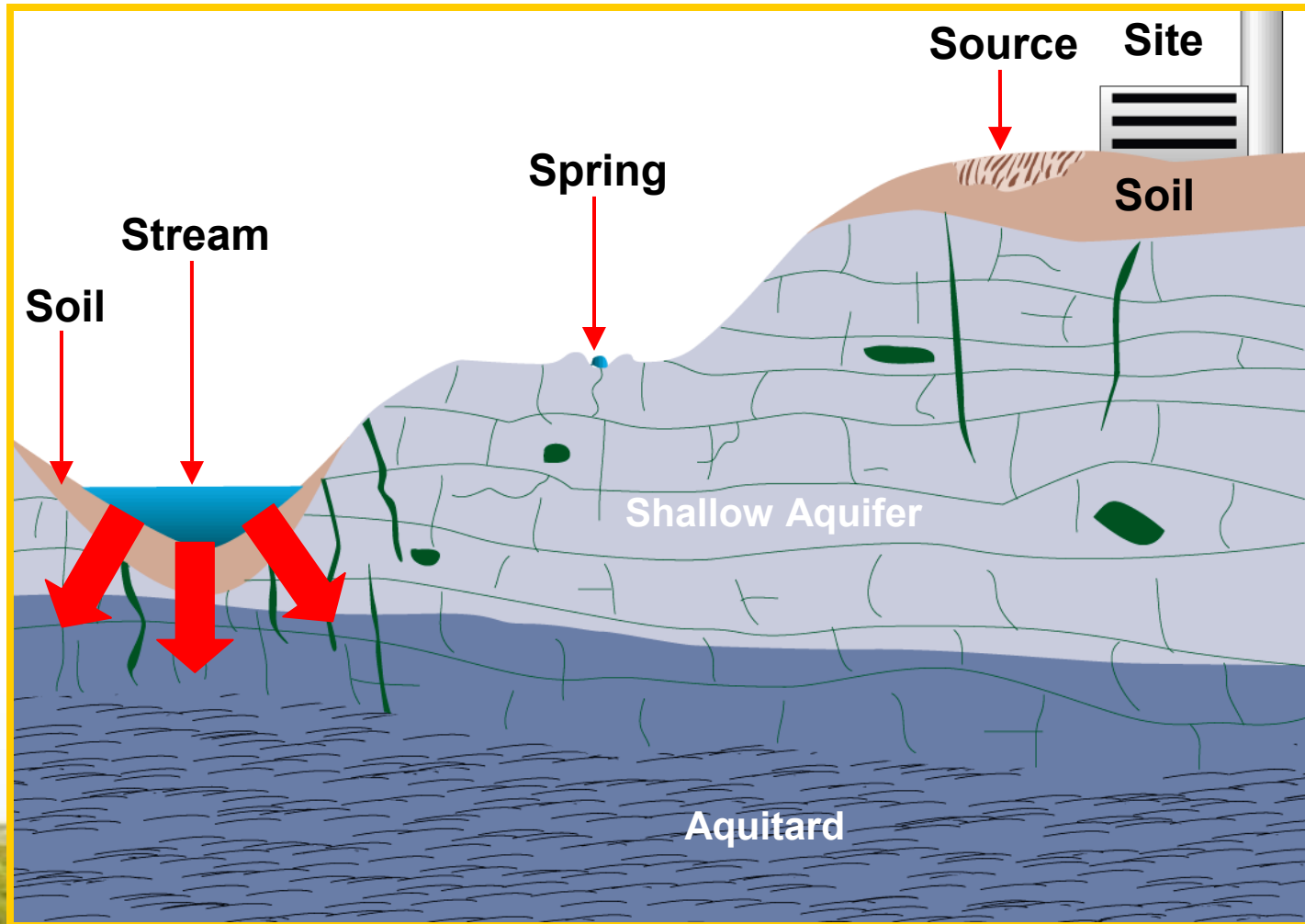




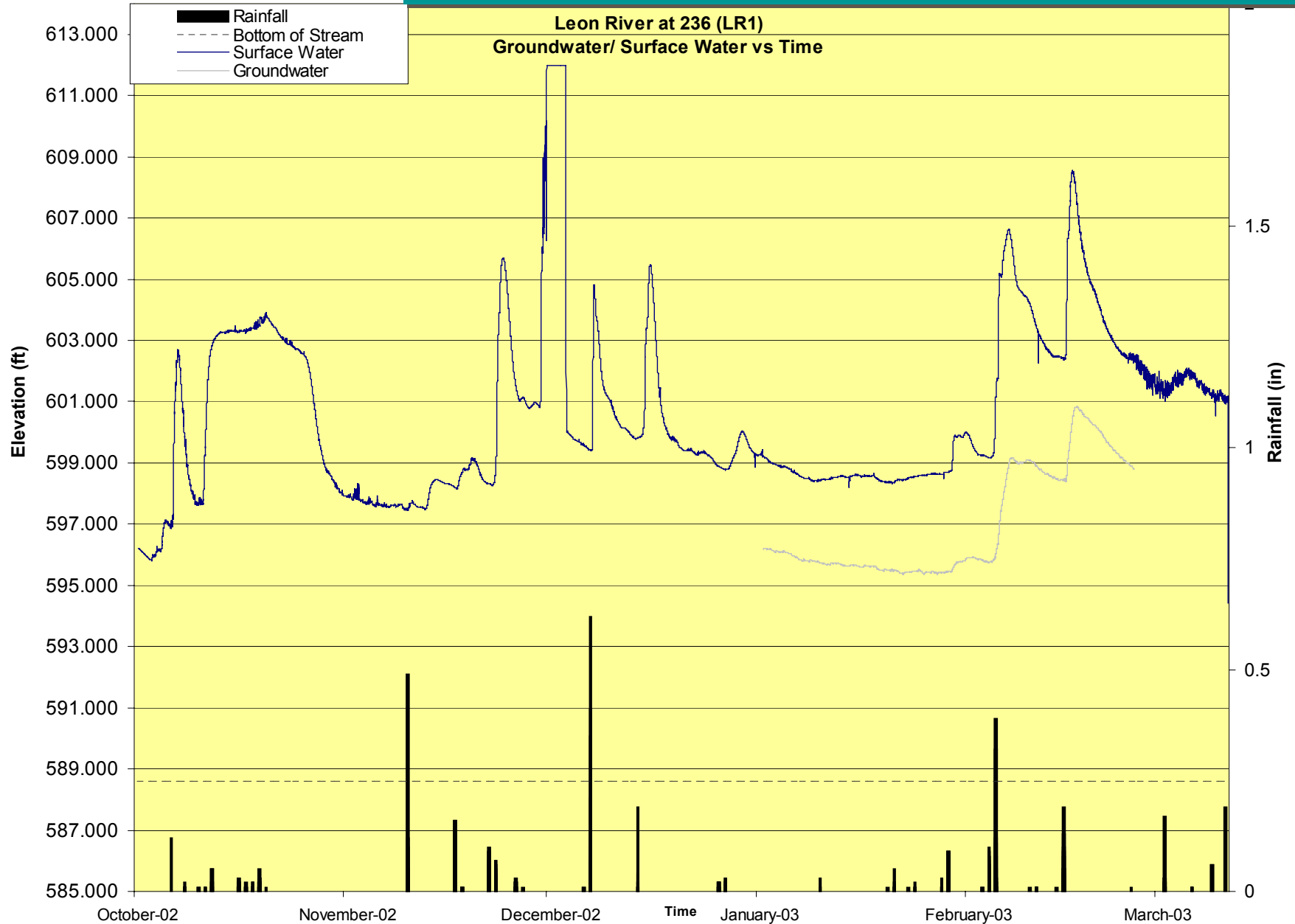
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# *Conceptual Site Model*

## *"Losing" Stream*



# Surface Water levels, Groundwater levels and Rainfall Relationships





# *Lake Belton Anoxic Study*

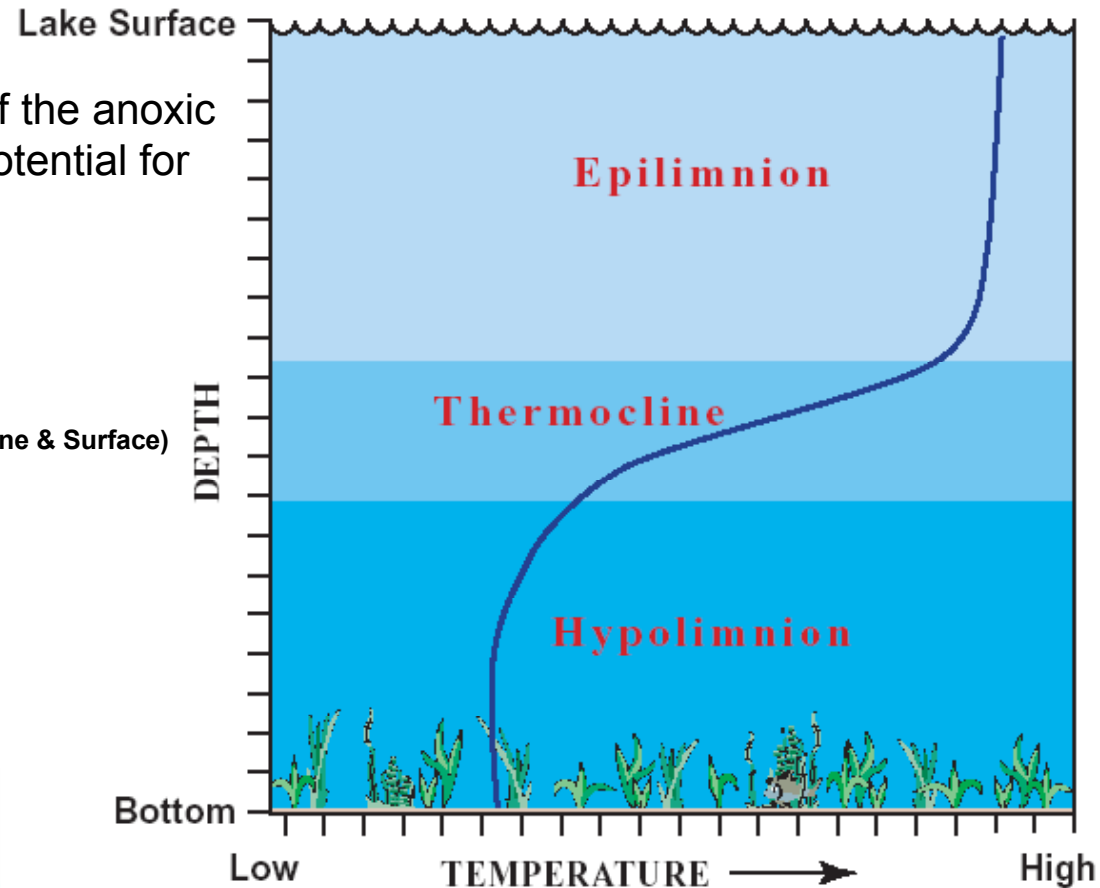
## Objective:

To provide a better understanding of the anoxic component of Lake Belton and its potential for perchlorate reductive metabolism

## Field activities completed:

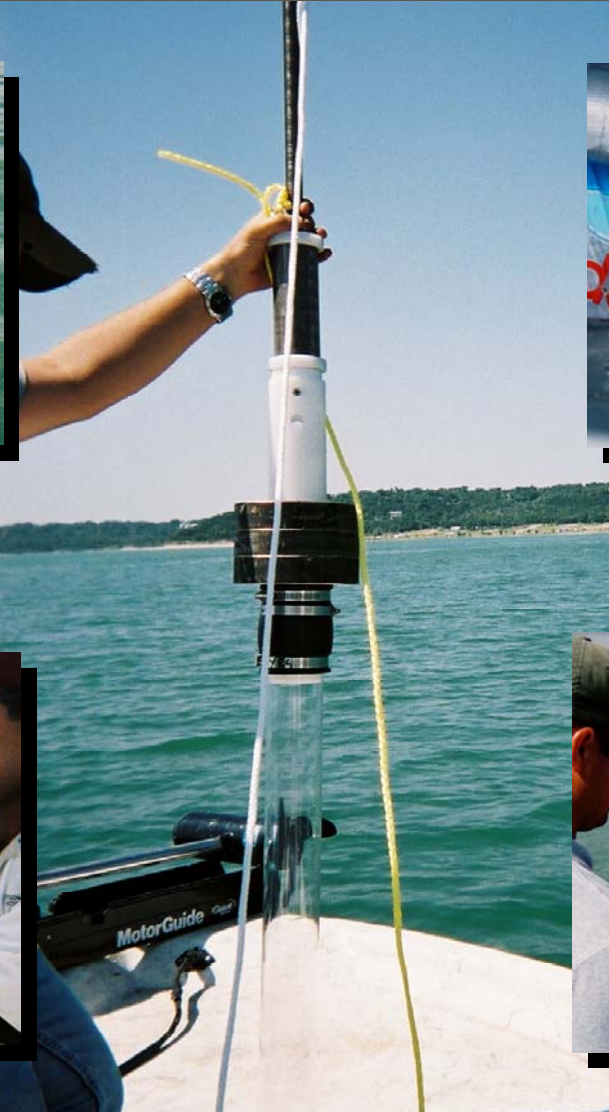
Collected samples from

- **Deep1** : Sediment, Water (Bottom, Thermocline & Surface)
- **Deep 2** : Sediment
- **Deep 3** : Sediment
- **Shallow 1** : Sediment, Water (Bottom)
- **Shallow 2** : Sediment
- **Shallow 3** : Sediment



# *Lake Belton Anoxic Study*

*(Retrieval of Sediment and Surface Water samples from Lake Belton)*



# ***Lake Belton Anoxic Study*** ***(Experimental Approach)***

## **Impacts on perchlorate degradation from:**

- **Medium (Sediment & Water)**
- **Medium variability**
- **Nutrients & Minerals**
- **Oxygen**
- **Temperature**





# *Lake Belton ADCP Study*

## **Objective:**

To better understand the  
flow patterns within Lake  
Belton.

## **Activities completed:**

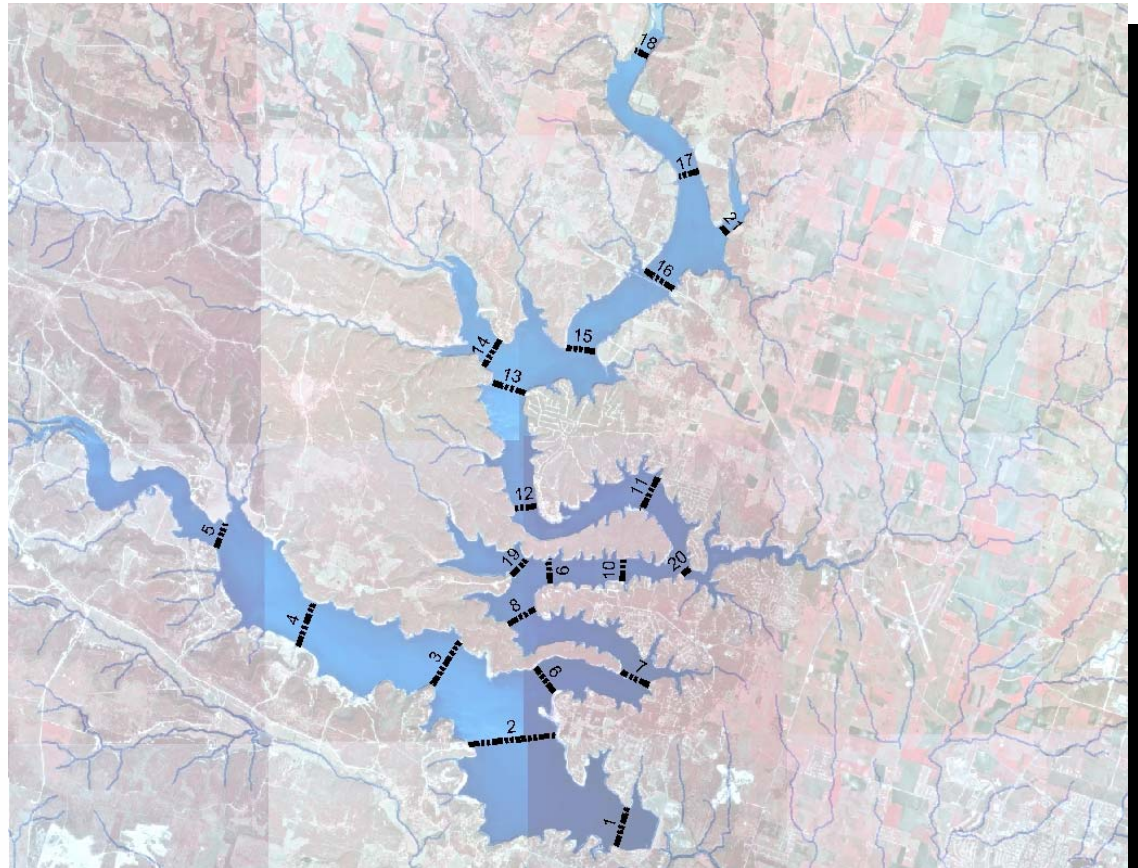
Spring 2003 event

Summer 2003 event

## **Activities to be conducted:**

Fall 2003 event

Winter 2003 event





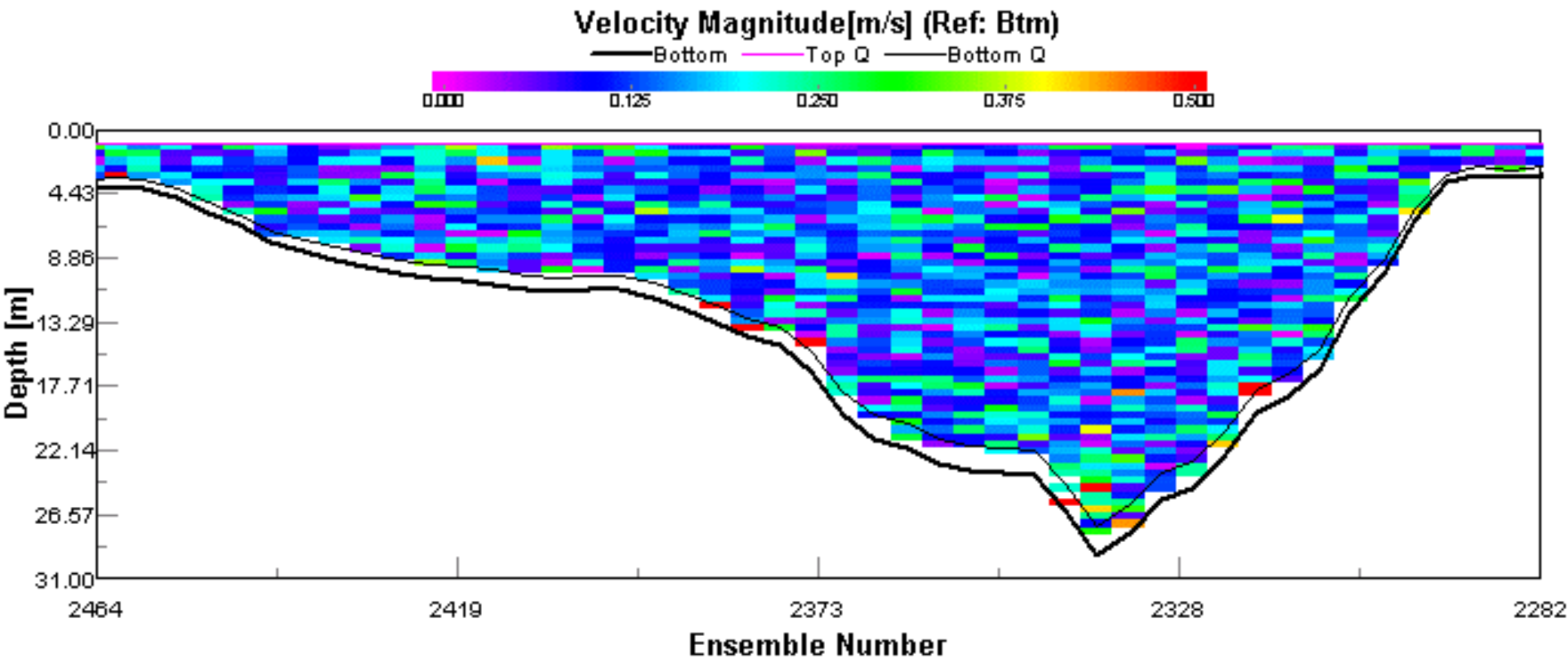
# *Lake Belton ADCP Study*

*(Survey across 21 transects in Lake Belton)*





# *Transect Cross Section and Flow Patterns*



## ***Lake Belton ADCP Study Observations***

- **Spring 2003 : Intuitive channel flow mostly in thalwegs – affected by wind, water level, and temperatures**
- **Summer 2003 : Uniform “slow” channel flow below the thermocline with some eddies – affected by wind**
- **Water temperatures during Summer nearly 50°F warmer than Spring**



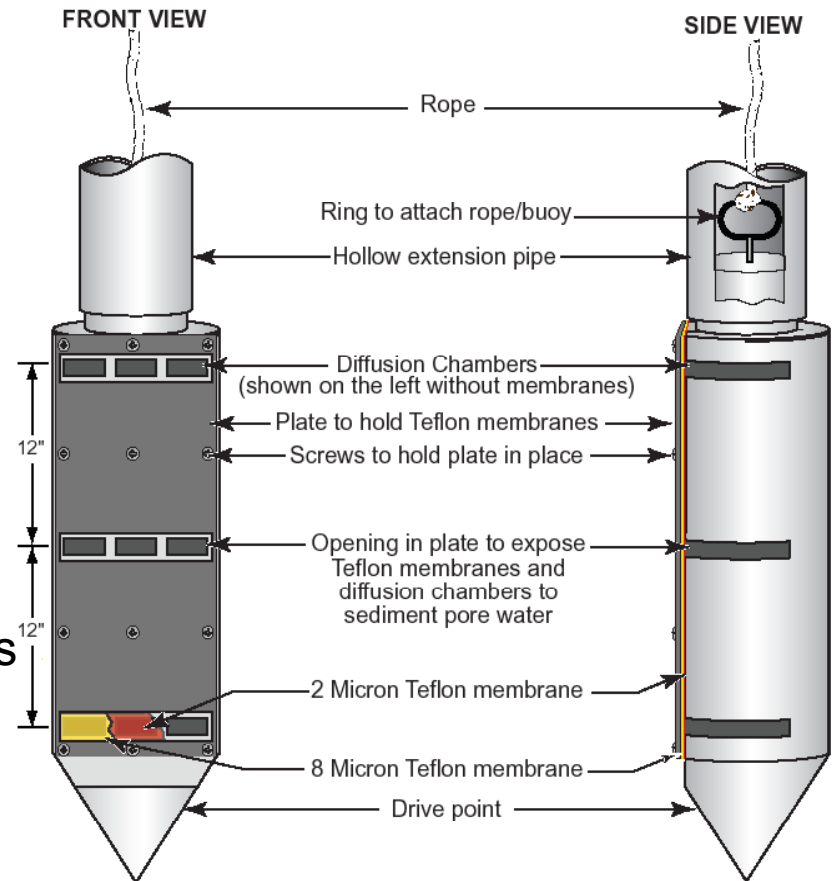
# *Lake Belton and Lake Waco Delta Area Study*

## Objective:

To study perchlorate concentrations in surface water and sediment pore water within the lake delta areas.

## Activities completed:

Collected and analyzed surface water and sediment water from the delta areas of Lakes Belton and Waco.



# Lake Belton Delta Areas Study Locations (from FSP)



**DELTA AREA**

*Lake Belton*

Cowen Rd.

## **EXPLANATION**

Sample grid point (actual grid locations will be established in the field, refer to Section 2.4.1)

U.S. Army Corps of Engineers  
BOSQUE AND LEON RIVER  
WATERSHEDS STUDY

DRAWING TITLE:

**LAKE BELTON DELTA AREA**



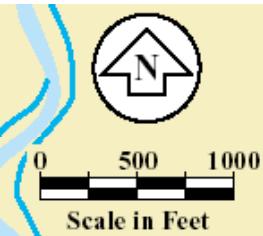
**MWH**  
MONTGOMERY WATSON HARZA

Sheet 1 of 1 sheets

SCALE  
1" = 2000'

FIGURE  
2-1

# Lake Waco Delta Areas Study Locations (from FSP)



## EXPLANATION

Sample grid point (actual grid locations will be established in the field, refer to Section 2.4.1)

DELTA AREA

Waco

U.S. Army Corps of Engineers  
BOSQUE AND LEON RIVER  
WATERSHEDS STUDY

DRAWING TITLE:

LAKE WACO DELTA AREA



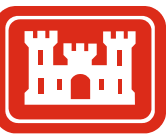
**MWH**  
MONTGOMERY WATSON HARZA

Sheet 1 of 1 sheets

SCALE  
1" = 2000'

FIGURE  
2-2





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# ***Lake Belton and Lake Waco Delta Area Study***

***(Installation of sediment pore water peepers, Collection of surface and sediment water peepers)***





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# ***Lake Belton and Lake Waco Delta Area Study Results***

## **LAKE BELTON DELTA AREA**

### **SAMPLING RESULTS**

<b>Surface Water (20 locations):</b>	<b>ND</b>	<b>(All 20 samples)</b>
<b>Sediment Pore Water (3 Samples at each of 19 locations):</b>	<b>ND</b>	<b>(All 57 samples)</b>

## **LAKE WACO DELTA AREA**

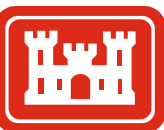
### **SAMPLING RESULTS**

<b>Surface Water (20 locations):</b>	<b>ND</b>	<b>(All 20 samples)</b>
<b>Sediment Pore Water (3 Samples at each of 20 locations):</b>	<b>ND *</b>	<b>(All 60 samples)</b>

*\* Preliminary data based on verbal results from USACE laboratory*

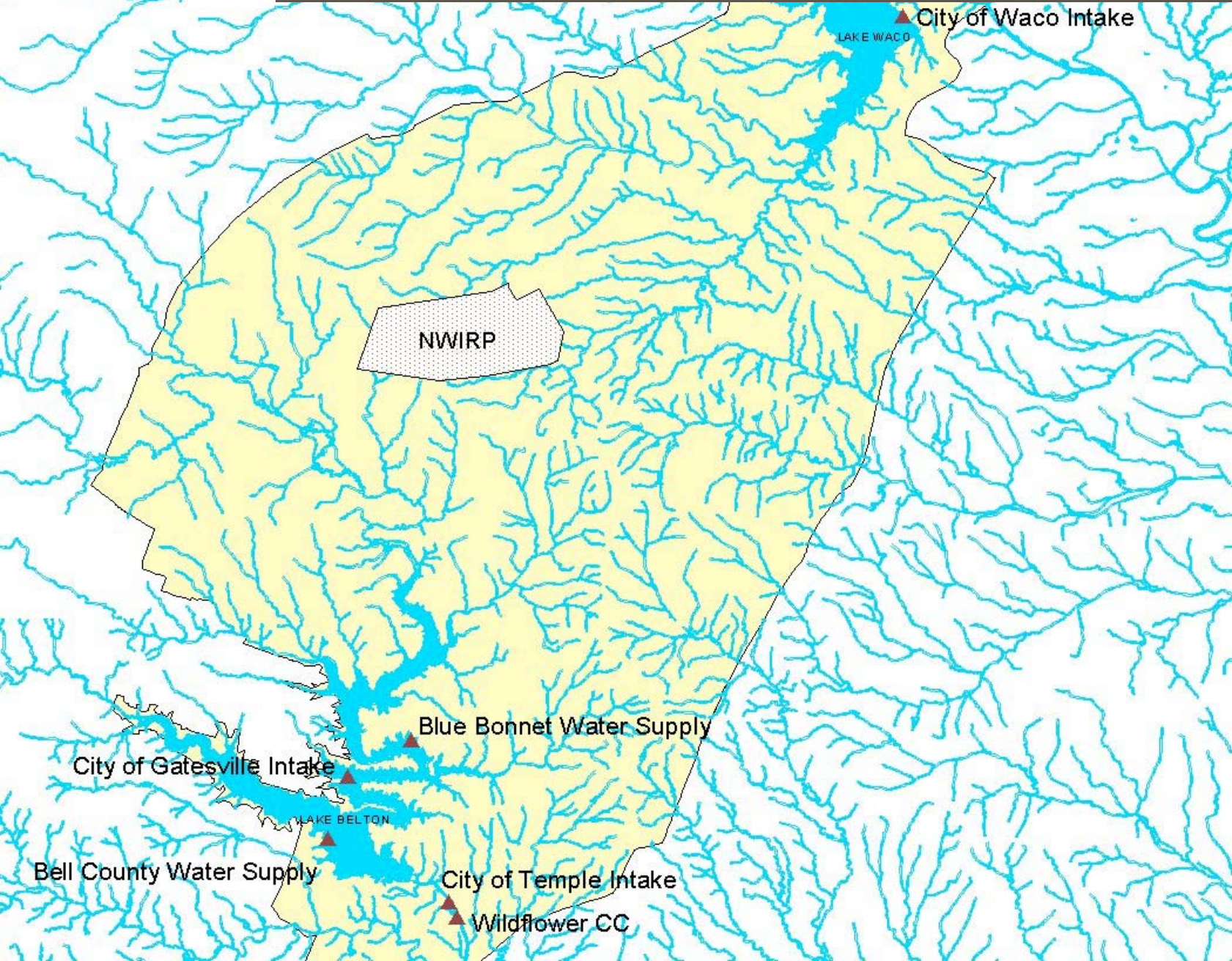






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# *Intake Sampling Locations*





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## ***Intake Sampling Results***

### **LAKE BELTON INTAKE SAMPLING RESULTS (Conducted by BRA)**

<b>January 2003</b>	<b>ND</b>
<b>February 2003</b>	<b>No sampling conducted</b>
<b>March 2003</b>	<b>ND</b>
<b>April 2003</b>	<b>Pending</b>
<b>May 2003</b>	<b>ND</b>
<b>June 2003</b>	<b>ND</b>

### **LAKE WACO INTAKE SAMPLING RESULTS (Conducted by City of Waco)**

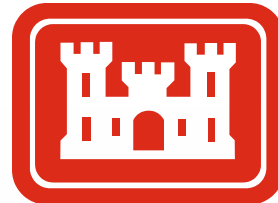
<b>January 2003</b>	<b>ND</b>
<b>February 2003</b>	<b>ND</b>
<b>March 2003</b>	<b>ND</b>





# ***Conclusion***

**Brian J. Condike**  
**Project Manager**  
**US Army Corps of Engineers**  
**Fort Worth District**



# ***Remaining Work to be Accomplished***

- **Complete field investigations to gain needed information.**
- **Geographic Information System (GIS) database.**
- **Ecological and toxicological assessment of study area.**
- **Complete an evaluation of the potential threat to human and environmental health.**
- **Prepare final project report**



# ***Preliminary Results***

## **Perchlorate:**

- Varies in surface water with location, season, and rainfall
- Is persistent in sediment
- Is found in various plant species
- Is found in small mammals and birds
- Is not affecting amphibian metamorphosis
- Is affecting fish thyroid tissues
- Can affect frog reproduction (male/ female ratio)



# ***Preliminary Results***

- Gaining and losing streams have been identified.
- Preferential flow patterns have been identified in Lake Belton during ADCP spring study.
- No perchlorate has been detected in the delta areas of Lakes Belton and Waco
- Perchlorate concentrations dilute significantly as they travel downstream from NWIRP.
- All samples collected from the Leon River, Middle Bosque and Cowhouse creek are below detection levels.
- All intake sampling performed by the study team have been below detection limits.







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# ***Conclusion***

# **Questions?**

